

CLAIMS

1 1. A flash method for a digital camera, said method  
2 comprising:  
3 a) activating a flash with a flash energy;  
4 b) grabbing an image to create image intensity data;  
5 c) analyzing corresponding image intensity data of an image  
6 derived from said flash to determine a flash degree of exposure;  
7 d) calculating a subsequent flash energy level to achieve  
8 a corrected degree of exposure;  
9 e) repeating steps (a) through (d) until an acceptable  
10 final flash energy level for achieving a correct exposure is  
11 determined; and  
12 f) activating a flash at the determined acceptable final  
13 flash energy.

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a 1 2. A method as in claim ~~1~~ further comprising a step prior to  
2 step (a) consisting of determining by analysis of ambient light  
3 or user election whether a flash is needed.

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a 1 3. A method as recited in claim ~~1~~ wherein said calculating  
2 includes multiplying the energy level of said flash by a pre-set  
3 constant factor if said flash degree of exposure is severely  
4 under exposed or severely over exposed.

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a 1 4. A method as recited in claim ~~1~~ wherein said calculating  
2 further includes

3 a) setting said subsequent flash energy level at the  
4 maximum flash energy level for a final flash energy level if two  
5 or more consecutive flash degrees of exposure are severely under  
6 exposed; and

7 b) setting said subsequent flash energy level at a minimum  
8 flash energy level for a final flash energy level if two or more  
9 consecutive flash degrees of exposure are severely over exposed.

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3 a) creating a histogram of quantity of said image intensity  
4 data versus intensity;  
5 b) preparing a bar graph with a multiplicity of regions  
6 from said histogram; and  
7 c) evaluating the quantity of data in each said region of  
8 said bar graph.

1 8. A method as recited in claim 7 wherein said calculating  
2 includes scaling said image intensity data to determine a  
3 scaling factor to multiply times said flash energy to calculate  
4 a final acceptable flash energy if said degree of exposure is  
5 under exposed or over exposed.

1 9. A method as recited in claim 8 wherein said scaling said  
2 image intensity data includes.

3 a) evaluating said histogram to determine a first intensity  
4 level above which a predetermined percentage of said intensity  
5 data lie; and

6 b) dividing a predetermined intensity level selected as a  
7 level at which said grabbing to create image intensity data  
8 becomes non-linear, by said first intensity level to create said  
9 scaling factor.

1 10. A method as recited in claim 1, wherein said calculating  
2 includes calculating a weighted average of a first energy level  
3 of a flash which resulted in under exposure, and a second energy

4 level which resulted in over exposure to obtain an estimated  
5 final flash energy level.

1 11. A method as recited in claim 2, wherein said determining by  
2 analysis includes

3 a) sampling a quantity of ambient light with said camera  
4 having a first set of camera parameters;

5 b) grabbing an image to create image intensity data;

6 c) analyzing corresponding image intensity data of an image  
7 derived from said ambient light to determine an ambient degree  
8 of exposure;

9 d) calculating subsequent camera parameters to sample a  
10 quantity of ambient light to achieve a corrected degree of  
11 exposure; and

12 e) repeating steps (a) through (d) until a said set of  
13 camera parameters are determined resulting in an acceptable  
14 quantity of ambient light for achieving a correct exposure, or  
15 until it is determined that a flash is needed.

1 12. A method as recited in claim 11 further comprising:

2 sampling a quantity of ambient light equal to said  
3 acceptable quantity of ambient light.

1 13. A method as recited in claim 3 wherein said calculating  
2 further includes

3 a) setting said subsequent flash energy level at the  
4 maximum flash energy level for a final flash energy level if two  
5 or more consecutive flash degrees of exposure are severely under  
6 exposed; and

7 b) setting said subsequent flash energy level at a minimum  
8 flash energy level for a final flash energy level if two or more  
9 consecutive flash degrees of exposure are severely over exposed.

1 14. A flash method for a digital camera, said method  
2 comprising:

3 a) activating a flash with a first flash energy;

4 b) grabbing a first image to create first image intensity  
5 data;

6 c) analyzing corresponding first image intensity data of  
7 said first image derived from said first flash to determine a  
8 first degree of exposure;

9 d) scaling said first flash energy if said first degree of  
10 exposure is under or over exposed to determine a final flash  
11 energy level; and

12 e) activating said flash at said final flash energy level.

29  
A 1 15. A flash method as recited in claim 14 further comprising:

2 a) multiplying said first energy level by a pre-determined  
3 factor if said first degree of exposure is severely under  
4 exposed or severely over exposed to determine a second flash  
5 energy level;

- 6           b) activating said flash with said second flash energy  
7   level;  
8           c) grabbing a second image to create second image intensity  
9   data;  
10          d) analyzing corresponding second image intensity data of  
11   said second image derived from said second flash to determine a  
12   second degree of exposure;  
13          e) scaling said second flash energy level if said second  
14   degree of exposure is under exposed or over exposed to determine  
15   a final flash energy; and  
16          f) activating said flash with said final flash energy.

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- 1   16. A flash method as recited in claim <sup>29</sup>~~15~~, further comprising:  
2           a) setting a final flash energy equal to a maximum flash  
3   energy if said second degree of exposure is severely under  
4   exposed;  
5           b) setting a final flash energy equal to a minimum flash  
6   energy if said second degree of exposure is severely over  
7   exposed; and  
8           c) activating said flash with said final flash energy.

- 1   17. A flash apparatus for a digital camera, said apparatus  
2   comprising:  
3           a) means for activating a flash with a flash energy;  
4           b) means for grabbing an image to create image intensity  
5   data;

6 c) means for analyzing corresponding image intensity data  
7 of an image derived from said flash to determine a flash degree  
8 of exposure;

9 d) means for calculating a subsequent flash energy level to  
10 achieve a corrected degree of exposure;

11 e) means for repeating steps (a) through (d) until an  
12 acceptable final flash energy level for achieving a correct  
13 exposure is determined; and

14 f) means for activating a flash at the determined  
15 acceptable final flash energy.

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1 18. An apparatus as in claim <sup>30</sup>~~17~~ further comprising means for  
2 determining by analysis of ambient light or user election  
3 whether a flash is needed.

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1 19. An apparatus as recited in claim <sup>30</sup>~~17~~ wherein said means for  
2 calculating includes means for scaling said image intensity data  
3 to determine a scaling factor to multiply times said flash  
4 energy to calculate a final acceptable flash energy if said  
5 degree of exposure is under exposed or over exposed.

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1 20. An apparatus as recited in claim <sup>30</sup>~~17~~ wherein said means for  
2 activating a flash with a flash energy includes  
3 a) means for detecting an initial voltage of a flash  
4 capacitor;

5           b) means for calculating a cutoff voltage of said flash  
6 capacitor at which voltage a quantity of energy equal to said  
7 flash energy is transferred to power said flash; and  
8           c) means for transferring a quantity of energy equal to  
9 send flash energy to said flash.

a 1   21. An apparatus as recited in claim <sup>30</sup>~~17~~ wherein said means for  
2 analyzing includes

3           a) means for sampling a first quantity of data from a first  
4 area of said image; and

5           b) means for sampling a second quantity of data from a  
6 second area of said image.

a 1   22. An apparatus as recited in claim <sup>30</sup>~~17~~ wherein said means for  
2 analyzing further includes

3           a) means for creating a histogram of quantity of said image  
4 intensity data versus intensity;

5           b) means for preparing a bar graph with a multiplicity of  
6 regions from said histogram; and

7           c) means for evaluating the quantity of data in each said  
8 region of said bar graph.

1   23. An apparatus as recited ~~in~~ claim 19 wherein said means for  
2 scaling said image intensity data includes



3 a) means for evaluating said histogram to determine a first  
4 intensity level above which a predetermined percentage of said  
5 intensity data lie; and

6 b) means for dividing a predetermined intensity level  
7 selected as a level at which said grabbing to create image  
8 intensity data becomes non-linear, by said first intensity level  
9 to create said scaling factor.

1 24. An apparatus method as recited in claim 17, wherein said  
2 means for calculating includes means for calculating a weighted  
3 average of a first energy level of a flash which resulted in  
4 under exposure, and a second energy level to obtain an estimated  
5 final flash energy level.

1 25. A flash apparatus for a digital camera, said apparatus  
2 comprising:

3 a) means for activating a flash with a first flash energy;

4 b) means for grabbing a first image to create first image  
5 intensity data;

6 c) means for analyzing corresponding first image intensity  
7 data of said first image derived from said first flash to  
8 determine a first degree of exposure;

9 d) means for scaling said first flash energy if said first  
10 degree of exposure is under or over exposed to determine a final  
11 flash energy; and

12 e) means for activating said flash at said final flash  
13 energy level.

a 1 26. A flash apparatus as recited in claim <sup>30</sup>~~25~~ further  
2 comprising:

3 a) means for multiplying said first energy level by a pre-  
4 determined factor if said first degree of exposure is severely  
5 under exposed or severely over exposed to determine a second  
6 flash energy level;

7 b) means for activating said flash with said second flash  
8 energy level;

9 c) means for grabbing a second image to create second image  
10 intensity data;

11 d) means for analyzing corresponding second image intensity  
12 data of said second image derived from said second flash to  
13 determine a second degree of exposure;

14 e) means for scaling said second flash energy level if said  
15 second degree of exposure is under exposed or over exposed to  
16 determine a final flash energy; and

17 f) means for activating said flash with said final flash  
18 energy.

1 27. A flash apparatus as recited in claim 26, further  
2 comprising:

3           a) means for setting a final flash energy equal to a  
4 maximum flash energy if said second degree of exposure is  
5 severely under exposed;  
6           b) means for setting a final flash energy equal to a  
7 minimum flash energy if said second degree of exposure is  
8 severely over exposed; and  
9           c) means for activating said flash with said final flash  
10 energy.

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